Remarks

Claims 1-37 are pending in the application, with claims 1, 18, 27, 34, 35, and 37 being the independent claims. Claim 35 is sought to be amended to correct a minor misspelling. This change is believed to introduce no new matter, and its entry is respectfully requested.

Amendments were made to the specification to correct minor informalities. An amendment was also made to the specification to change reference numeral 302 in paragraph 53, line 7, to correctly designate diffuser 320 to be consistent with Figure 3A as originally filed. Similarly, an amendment was also made to the specification to change reference numeral 440 in paragraph 62, line 7, to correctly designate camera system 450 to be consistent with Figure 4 as originally filed. These changes are believed to introduce no new matter, and their entry is respectfully requested.

An amendment was made to the Abstract to correct a minor informality. This change is believed to introduce no new matter, and its entry is respectfully requested.

Conclusion

Favorable consideration of all pending claims is respectfully solicited. If the Examiner believes, for any reason, that personal communication will expedite prosecution

of this application, the Examiner is invited to telephone the undersigned at the number provided.

Respectfully submitted,

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Version with markings to show changes made

In the Specification:

Please amend the following paragraphs/sections as follows:

Amend paragraph 4, as follows:

Collimated light has been used in an illumination source for a print scanner to reduce the power required. A collimated lens collimates incoming light rays so that collimated light rays exit which travel parallel to one another. Because the rays are made parallel they travel efficiently through a telecentric optical system. FIG. 1A shows an example of a collimated light source lighting technique. A single discrete light source 110 emits light over an area as indicated by example rays 112. The actual emission area depends upon the type of emitter and other factors such as whether a lens, light guide or other optical element is provide<u>d</u> to focus or guide the emitted light. A subset 115 of rays 112 are collimated by collimating lens 120 and emerge as parallel rays 125. The subset rays 115 are those rays within an angular range A at the focal point of collimating lens 120 as shown in FIG. 1A.

Amend paragraph 8, as follows:

FIG. 2 shows an example print scanner using a diffuse light source 205 that illuminates prism 130. Diffuse light source 205 includes a discrete emitter array 210 and a diffuser 220. Discrete emitter array 210 is made up <u>of</u> a number of evenly spaced light emitting diodes that emit red light. As shown schematically in FIG. 2, diffuse light source 205 is an inefficient light source for generating an image and passing the image to an image sensor in a telecentric system. Diffuse light travels randomly or in different directions and is not transmitted through an entire telecentric system. For instance, much of the light is blocked by aperture 150. Such inefficiency in illumination of a print scanner is undesirable as it increases the number of emitters needed in array 210 and the power requirements of array 210. This problem is even more acute for telecentric print scanners where flat, uniform illumination is needed across a relatively large platen, such as, a platen big enough to allow capture of images for a roll print or slap print of one or more fingers, or a palm print.

Amend paragraph 53, as follows:

FIG. 3B illustrates how such advantages are achieved in the operation of a hybrid diffuse/collimated illumination system according to the present invention. Illumination source array 310 is placed at a distance equal to or less than the focal length of collimating lens 330. In FIG. 3B, array 310 is shown between a focal point FP of the collimating lens

330 and the lens 330 itself. At least a part (or portion) of the light emitted by illumination source array 310 will pass through diffuser 320 (not shown) and diffuser 325. Each diffuser [302] 320, 325 acts to randomize the light so that rays travel in many different directions. Only a few rays 311, 312 of the diffuse light are actually shown in FIG. 3B for clarity. Collimating lens 330 receives all or part of the diffuse light rays 312 from diffuser 325. A first portion of the diffuse light indicated by rays 314 is collimated by collimating lens 330 and sent in parallel toward prism 340. This first portion of rays 314 generally corresponds to that portion of rays 312 traveling as if they originated within a cone at focal point FP. The remaining portion of diffuse light indicated by rays 316 that passes through collimating lens 330 falls on the platen as diffuse light. Such diffuse light acts as fill light and allows grey scale shading of a print to be detected by an image sensor.

Amend paragraph 54, as follows:

FIG. 3B further illustrates how a grey scale shaded image of a finger or palm illuminated by rays 314, 316 is obtained. Only one ridge between two valleys is illustrated and enlarged for clarity. The figure is illustrative and is not an actual ray trace drawn to scale. The total illumination (that is, rays 314, 316) incident upon platen 342 arrives from a number of different directions. Ridges act to absorb rays at certain incident angles, while valleys act to reflect rays at certain incident angles. The actual angles at which absorption or reflection occurs depends upon, among other things, the indices of refraction of the ridge, the air at the valley, and the prism and platen. In addition, for some incident angles, diffuse light that falls on the platen surface passes through the platen surface and illuminates a valley. Light reflected from the skin of a ridge at the proper angle, then re-enters the prism and is transmitted to the sensor plane. This light enhances the grey scale range and provides a more desirable image.

Amend paragraph 61, as follows:

FIGS. 4 and 5 illustrate a further embodiment of the present invention. FIG. 4 is a diagram of an illumination system 400 in a print scanner having a light wedge 420. An illumination source array 310 inputs light at an end region 426 of light wedge 420. Light is internally reflected within light wedge 420 and passes to a reflector/diffuser surface 422. Reflector/diffuser surface 422 is one angled face or surface of light wedge 420. Preferably, surface 422 is provided at an angle with respect to the optical axis along which light is emitted by illumination source 310. In one embodiment, reflector/diffuse surface 422 acts to both reflect light and make the reflected light more diffuse. As shown in FIG. 5, light rays 500 emitted by illumination source 310 pass through light wedge 420 to impinge on reflector/diffuser surface 422. Diffuse, reflected rays 510 then pass from surface 422 out through the surface 424 of light wedge 420. For clarity, other ray paths illustrating the internal reflection of light within light wedge 420 are omitted. This internal reflection

within light wedge 420 provides a further advantage, however, as it tends to make the light even more diffuse and improve grey scale shading.

Amend paragraph 62, as follows:

As shown in FIG. 4, light passing from surface 424 or light wedge 420 then passes to diffuser 430. Diffuser 430 makes the light even more diffuse so that uniform illumination is provided to platen 342. When a finger is placed on platen 342 as shown in FIG. 4, an image of the finger is then sent through optical system 440 to camera system 450 for detection and processing. Optical system 440 can be any conventional optical system in a print scanner. Similarly, camera system [440] <u>450</u> can be any type of camera including, but not limited to, one or more CCD or CMOS cameras.

Amend paragraph 73, as follows:

FIG. 7 is a diagram illustrating an illumination scheme for a print scanner 700 highlighting the effect of a blue/green illumination source on a valley of a finger according to an embodiment of the present invention. Print scanner 700 comprises, *inter alia*, an illumination source 702, a diffuser 704, a prism 706, and a camera 708. A finger 710 is placed on a platen. In this example, the platen is a top outside surface of prism 706 or any other surface that receives illumination from the top of the prism 706. For example, the platen can be a silicone layer or other protective layer or element provided on top of or in optical contact with prism 706.

In the Claims:

Please amend claim 35 as follows:

35. (Once Amended) For use in a print scanner, an illumination method for improving a range of grey scale shading, comprising:

emitting light in a blue/green spectrum from a plurality of discrete sources; and

illuminating a platen with at least part of the emitted light in the [blue/greem] <u>blue/green</u> spectrum.

In the Abstract:

Please substitute the existing Abstract on page 29, line 3, with the following new Abstract:

Systems and methods for illuminating a platen are provided. A hybrid illumination system uses both diffusion and collimation to efficiently provide a flat, uniform illumination

at a platen. One or more diffusers are disposed between the illumination source array and a collimating lens. An illumination system is provided which uses diffused light to illuminate a platen in a print scanner. The illumination system has an illumination source array and a light wedge. The light wedge reflects light internally which makes the illumination even more diffuse. An illumination source array has a plurality of sources that emit blue/green light. In one preferred example, the blue/green light is equal to or approximately equal to 510 nm. Sources are divided into at least a center region and a perimeter region. The density of sources provided in the perimeter region is greater than in the center region to correct for natural light falloff in the illumination system. Intensity control can be [preformed] performed individually or in groups.